DOCUMENT RESUME

ED 374 778 IR 016 821

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TITLE Creating Electronic Performance Support Systems for Australian Graduate Students in Computer Education.
PUB DATE Apr 94
NOTE 9p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 4-8, 1994). Original printed on colored stock.
PUB TYPE Reports - Descriptive (141) -- Speeches/Conference Papers (150)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS *Computer Assisted Instruction; *Computer Software Development; Educational Media; Educational Technology; Evaluation Methods; Foreign Countries; Higher Education; Hypermedia; *Multimedia Instruction; Research and Development
IDENTIFIERS Australia; Interactive Systems; Multimedia Materials; *Performance Support Systems

ABSTRACT

This paper describes research and development concerning the use of electronic performance support systems (EPSS) in interactive multimedia (IMM) classes at Edith Cowan University (ECU), Australia. EPSS are a special type of computerized support systems that integrate a knowledge base with practical tools required for a specific type of job. The use of an EPSS in the context of an IMM course is seen as appropriate given the heavy emphasis that is placed on the practical application of theory to large scale project work. The current IMM Project EPSS prototype consists of an information base and software tools with links between them. The first two research and development phases are characterized by qualitative research accompanied by concurrent development and evaluation. Phase 1 (Initial Assessment) consists of product design, development, and evaluative research. Phase 2 (Assessment of Initial Implementation) will determine the effects of implementing learning strategies based on the IMM EPSS on 30 graduate students. This assessment may result in new or modified research questions and software modifications for the EPSS. (JLB)

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Creating Electonic Performance Support Systems for Australian Graduate Students in Computer Education

by Dr. Geoff Ring

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Creating Electronic Performance Support Systems for Australian Graduate Students in Computer Education

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Introduction

Raybould (1990) describes an Electronic Performance Support System (EPSS) as "a computer-based system that improves worker productivity by providing on-the-job access to integrated information, advice, and learning experiences." EPSSs are a special type of computerised support system that integrate a knowledge base with practical tools required for a specific type of job and they are becoming increasingly common in industry to enhance employee performance. This paper describes research and development concerning the use of EPSSs in Interactive Multimedia (IMM) courses at Edith Cowan University.

Systems are usually built to deal with the need for efficiencies when a team of people is required to complete a complex task. This is the situation confronted by students enrolled in two of the University's IMM units for graduate students, *Courseware Engineering* and *Interactive Multimedia Courseware Project*. These units are the third and fourth of a sequence of four units aimed at developing knowledge and skills in the area of IMM, particularly in relation to computer-based training and information systems applications. These units require students to produce advanced prototypes of IMM products which are as close to professional quality as is possible given the limited time and resources available to them.

An EPSS for Interactive Multimedia Projects

The use of an EPSS in the context of the IMM course is seen as appropriate given the heavy emphasis that is placed on the practical application of theory to large-scale project work. *Courseware Engineering*, for example, requires students to work in peer-based teams to develop an IMM program for an academic client within the University. *Interactive Multimedia Courseware Project* requires them to play a significant role in an IMM project team in an education or industry training context of the student's choice, preferably one closely related to their current or future work environment. While the EPSS is initially being developed specifically for use in these units it has the potential to be used for IMM development generally.

Two major components of the EPSS for IMM projects are currently under development: an information base and a set of tools. A third component (an advisory/expert system) will be incorporated at a later stage. The information base provides textual information on selected topics in a hypertext format and relevant portions are linked to tools which are separate files created with external computer software applications. The EPSS serves as a resource for the students, providing the information and/or tools they need for a given situation. It is hoped that the final product will also serve as an "intelligent" assistant and as a tutor, guiding the user to a more complete understanding of the concepts and principles involved in the tasks they undertake.

The information base contains current and relevant information but does not attempt to be an in-depth "electronic book". Information is kept brief with the provision of context-sensitive help and references to other resources. The student is guided from within the knowledge base as to how to use the tools appropriately. Blank tool forms (usually interactive templates that can be modified and printed out) are supported by completed "sample" forms where appropriate.

The EPSS includes tools such as a "Needs Assessment Questionnaire" or a "Formative Evaluation Instrument" intended for use, with or without modification, by IMM team members. The EPSS is being implemented using the commercial software programs *Authorware Professional*, *Microsoft Word* and *Microsoft Excel* and will be available on both IBM/Windows and Macintosh hardware platforms.

Why use an EPSS?

In addition to their role in initial training, EPSSs can also be valuable resources for experienced personnel. Such people possess varying degrees of skill, knowledge, and creativity in their field of expertise, and a worthwhile EPSS should make them more efficient, more effective and more creative. EPSSs can also be used as electronic texts. There are a few examples of EPSSs being used in this way (e.g. Gustafson & Reeves, 1994) and the initial feedback concerning such use appears positive.

Students in the IMM units are required to take on various roles in project teams (programmers, instructional designers, computer graphics designers, subject matter experts, project managers, etc) and they have previously relied heavily on paper-based information to update or confirm their ideas concerning a particular role in a given project. Such paper-based products are often outdated and the relevant information can be difficult to locate. For these reasons IMM team members have often fallen back on information and structures they have used previously (say, from traditional educational media production) which are usually inappropriate. The proposed EPSS will clearly identify those tools and aspects of the knowledge base that are normally needed for each of the IMM project team members.

Background

CPE Toolbox

In the second semester of 1993, Professor Thomas C. Reeves, an Edith Cowan Visiting Fellow from The University of Georgia, worked with students in both IMM courses described above and introduced the idea of using EPSSs as a learning aid, an information resource and a "toolkit." The students had access to three EPSSs: *ID Library* and *Evaluator's Toolbox*, developed and used by graduate students and staff at The University of Georgia, and *CPE Project Toolbox*, specifically tailored by Reeves to meet the needs of the ECU students.

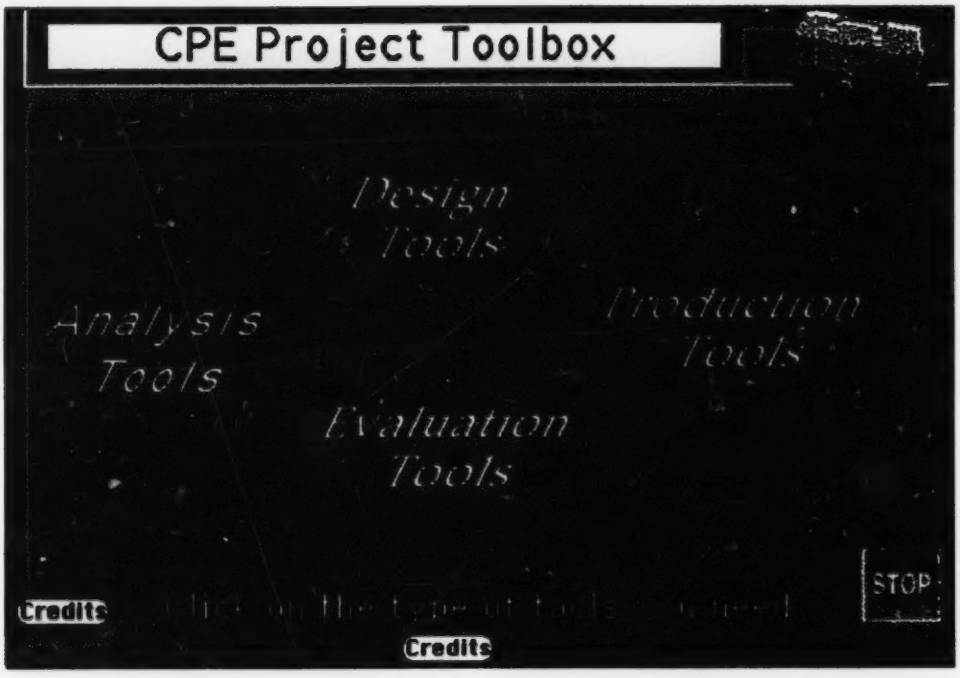

Figure 1. Main interface for the *CPE Project Toolbox* EPSS.

CPE Project Toolbox (see Figure 1) included tools designed to assist students in the completion of tasks such as a "Project Status Report" template for reporting on project progress

and a "Development Activity Log" for keeping track of the hours students spend on various aspects of their projects. *CPE Project Toolbox* was implemented using the commercial software programs HyperCard and Microsoft Works. The information base was provided in a hypertext format.

Feedback from course evaluation questionnaires indicated that the use of the EPSSs in the context of the IMM courses was seen by both students and staff at ECU as appropriate and helpful, the main reason given being the assistance it provided in project work. Preliminary research concerning student reactions to Reeves' *CPE Project Toolbox* EPSS indicated that they adopted a positive, businesslike manner with respect to using the EPSS to assist with their course projects.

IMM Project

In December, 1993, a decision was taken to conduct research and development work in relation to a new EPSS designed to improve the productivity of IMM project teams. The main difference between the proposed EPSS and those introduced by Reeves was its more specific orientation towards IMM and its coverage of all facets of the IMM design and development process. The EPSSs introduced by Reeves were more generic and could be applied to a range of training programs and products. The project team was established in December and consisted of four graduate students, with the author playing a project management/client role. The goal of the IMM project was to develop a product to support IMM projects!

Where appropriate, the new *IMM Project* EPSS (see Figure 2) drew upon ideas embodied in the EPSSs introduced by Reeves. The product has reached an early prototype stage and initial assessment with students currently enrolled in *Courseware Engineering* has commenced.

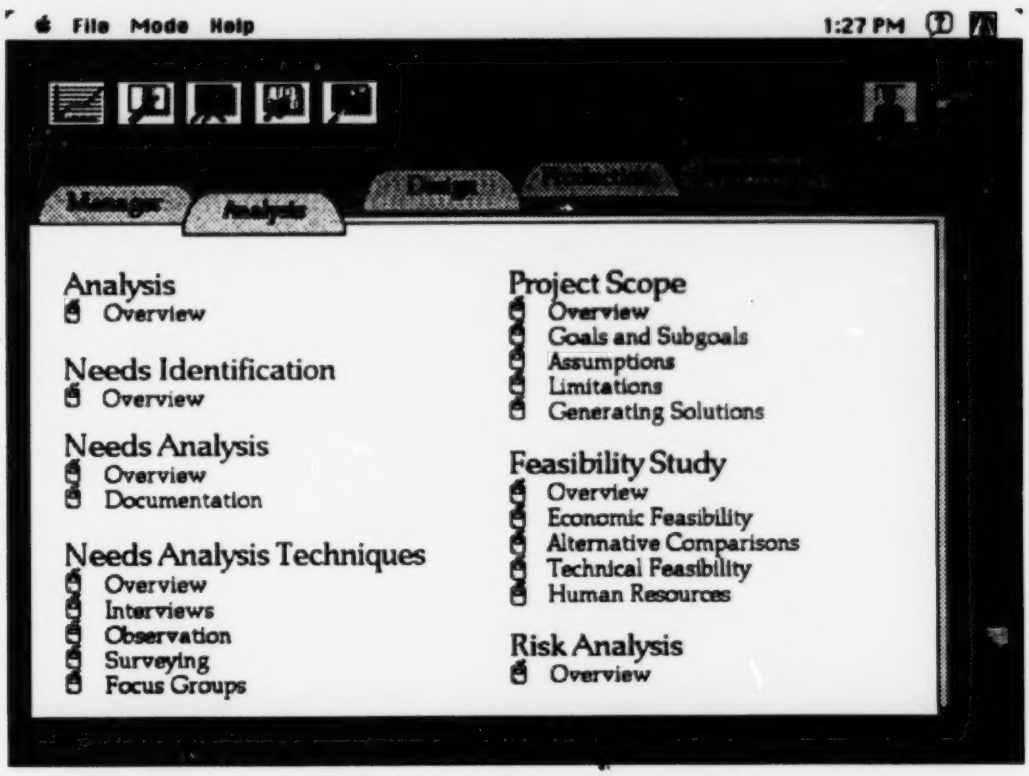

Figure 2. Main interface for the *IMM Project* EPSS.

Rationale

Performance support systems differ from traditional computer-based training in at least two fundamental ways:

(1) they emphasise performance (designers of EPSSs need to go beyond standard instructional design methodologies and incorporate performance technology principles); and

(2) the locus of control shifts to the learner (the user has greater control over their learning and the role of the instructor is primarily that of a facilitator and guide).

Gery (1991), perhaps the most significant of the early protagonists promoting the use of EPSSs, proposed the following ten "assumptions" as a basis for new approaches to learning:

- *Learning is a process, not an event ...*
- *Groups of learners are rarely similar ...*
- *Learners control what they learn and retain ...*
- *When information about things is forced on people out of context, it is difficult to obtain and maintain their attention ...*
- *Learners will learn in the most efficient and effective way for them personally ...*
- *When provided with a model or benchmark as a basis for comparison, learners can assess their own knowledge and skill without the involvement of others ...*
- *In order to become skilled or proficient at anything, people must have sufficient practice in actually doing the task ...*
- *Consistent training experiences produce inconsistent and unpredictable learning outcomes because of the diversity of the learning audience ...*
- *Most post-training job support is unstructured, inconsistent, inadequate, or inaccessible ...*
- *The job situation is dynamic. Change is frequent; ongoing adaptation and learning is required ...* (p. 20-22)

There is nothing new or surprising in Gery's list of assumptions. Support for her view of learning and competency building as an integrated, situated and goal directed process can be found in the literature in areas such as situated cognition, cognitive apprenticeship, contextualized learning, generative learning, reflective learning, etc. Nevertheless, Gery has played a significant role in re-directing the attention of educators, particularly industry trainers, towards these educational approaches. While some of Gery's assumptions may be less relevant to university education than industry training, the challenge to provide learning which is individualized, interactive, "in context" and "just- in-time" is an important one for all sectors of education, universities included.

Changing Models for Training

During the Twentieth Century the progress of mass industrialization resulted in the traditional classroom training model gradually replacing the apprenticeship model which could not cope with the increasing numbers of people who needed to be trained. Over the last twenty years the world has entered an information explosion era where learning is now recognized as a continuous, lifelong process with the result that the traditional classroom model has now become less than adequate for many purposes.

In the words of Gery (1991, p. 29), "throwing on more traditional training events, regardless of whether they are interactive or not, will not result in the required performance." We have the technology to develop viable alternative learning models, but, according to Gery, it is essential that we stop applying technology to old models and paradigms and that we accept a change in emphasis from "teaching to learning and then to performance" and from "rigidly defined content and training ... [to] learning experiences created by the learner" (p. 30). This point is reinforced by Scales & Yang (1993) who suggest that what is lacking is,

> "... technological advancements geared towards supporting and training the employee on-the-job at the employee's moment of need. Because jobs are becoming so specialized, complex and dynamic, it is impossible to provide detailed training before a job is started. It is even more difficult to support, at the right time, all employees at their specific moment of need." (p. 3).

While the world of industry and commerce is starting to come to terms with the fact that new paradigms for learning are needed in today's technology-based, information-oriented world, educational institutions have shown limited interest and are running the risk of decreasing their relevance and marginalizing their role in society.

Research and Development

The current *IMM Project* EPSS prototype consists of an information base and software tools with links between them. The sections of the information base, and the various tools, are at different stages of completion. Hypertext searching facilities, alternative views of content, instructional sequences and an "intelligent" advisory system are planned for gradual incorporation. The first two R & D phases are characterized by qualitative research accompanied by concurrent development and evaluation. The research component of the third phase, which is still expected to involve some product development, will be characterized by an appropriate mix of quantitative and qualitative research approaches (see Figure 3). The first phase is underway, the second phase is planned for the second half of 1994, and the third phase is planned for 1995.

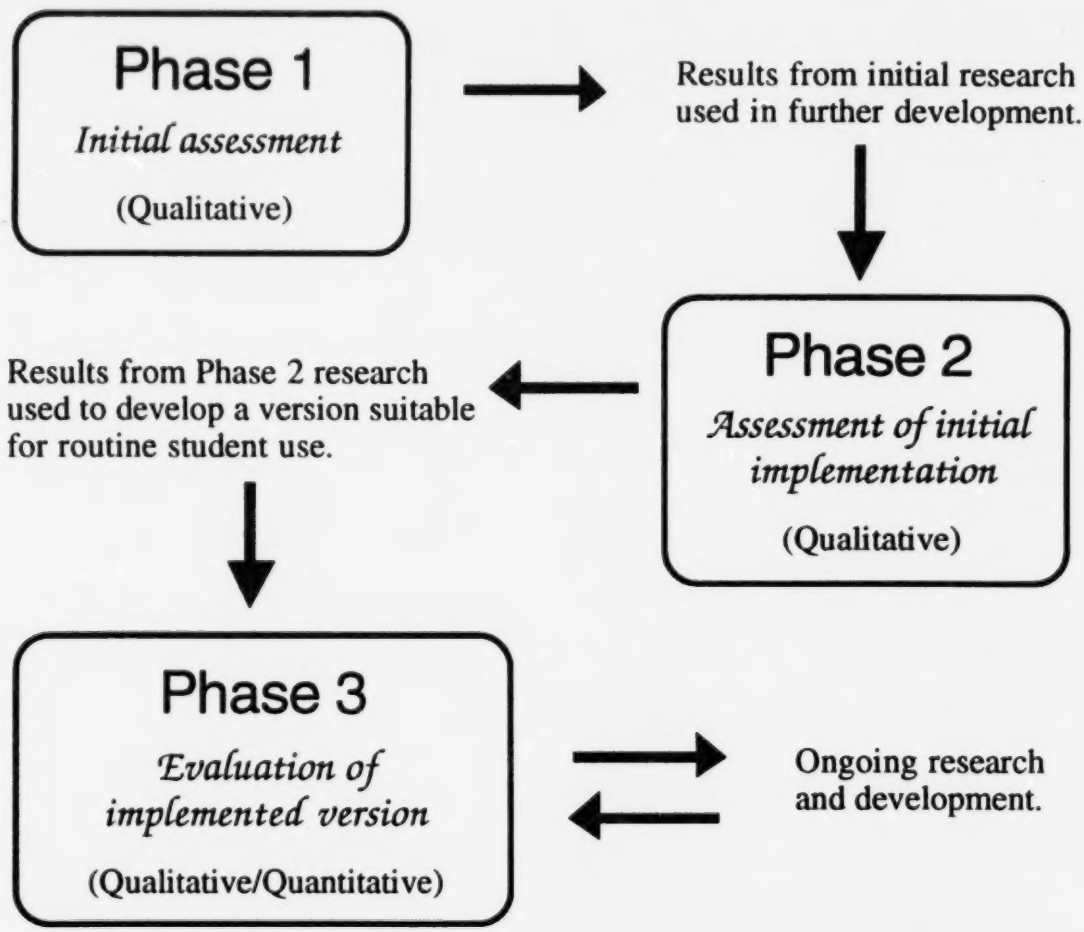

Figure 3. Overview of Research and Development Plan, 1994 - 1995.

Phase 1 (1994, Semester 1) Initial Assessment

This initial (current) phase consists of product design and development and "evaluative research". The evaluation of a "developing" EPSS prototype is being done in context (that is, in relation to the course *Courseware Engineering* for which the EPSS is being initially developed) using 10 evaluators categorized as follows:

- 4 students of the current 94/1 class, who have regular access to the EPSS prototype;
- 3 students of the inaugural 93/2 class, who are also members of the development team;
- 2 instructors involved in the course, who are also members of the development team.

The evaluation process is aimed at determining differences between the existing characteristics of the EPSS prototype and the desired characteristics. The main procedures employed here consist of group discussions, interviews and a formative evaluation instrument designed for IMM products. The EPSS and the methods used to assess it will be modified during the course of the semester, based upon the findings of the evaluation team. It is expected that research questions, in addition to those listed below in phase 2, will be generated in the light of results from the initial assessment.

Phase 2 (1994, Semester 2) Assessment of Initial Implementation

The goal in this phase is to determine the effects of implementing learning strategies based on the use of the *IMM Project* EPSS with approximately 30 graduate students enrolled in the 94/2 class of *Courseware Engineering*. It is intended to conduct assessment of both the direction of the research and the design of the EPSS at two points in time, approximately mid-semester and end of semester. This re-assessment may result in new or modified research questions and/or software modifications to the EPSS. Three broad questions will guide the initial efforts in this phase:

1. What are the attitudes of the students toward the EPSS?
2. How do students and staff use the EPSS in their IMM courses?
3. What are the effects of the EPSS on the quality of student learning, as perceived by both staff and students?

Observations, interviews, and questionnaires will be employed to collect the data necessary to address these three questions. These qualitative data collection methods will be carried out and interpreted by the developers of the EPSS and a valid portrayal of the uses and results of the product is expected. The EPSS and the methods used to answer the questions above will be modified during the course of the study on the basis of student feedback in line with standard qualitative techniques. The dynamic nature of the research reflects the reality of the ongoing responsive development effort carried out by the investigators and the "insiders view" will result in high internal validity. This is the approach believed most likely to lead to the establishment of a theoretical framework and is the approach most capable of adjusting to the changing context between the three phases. It is important that a theoretical framework be established to support the approach to learning embodied in the EPSSs. How should knowledge be organized and made accessible to best facilitate learning? What is the cause of poor performance? These and other questions need to be investigated. Research by cognitive theorists, particularly those in the area of "situated learning", should assist in establishing a theoretical base for the claimed strengths of EPSSs.

Conclusion

IMM courses often require students to produce prototypes of IMM products that are of near-professional quality. The provision of an EPSS such as *IMM Project* should provide them with high quality information, advice and tools to support their performances in a variety of roles. EPSSs are becoming more commonplace in large companies, military training centres, and even in higher education (Laffey, 1992). It is important that IMM graduate students work with similar tools during their professional preparation.

Taking the wider view, the increasing implementation of open learning principles and distance education procedures to deliver university education means that many of the arguments given above in support of using EPSSs (individualized, "just-in-time", etc) will increasingly apply to university education. In that respect, the research and development effort in relation to the EPSSs referred to in this paper, and others like them, may themselves be "just-in-time".

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